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Baseline Childhood Farm Safety Data for Indiana

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Survey responses indicate that on Indiana farms where children reside or frequently visit, 63% of owner/operators allow children to ride as passengers on tractors and/or combines, and 36% allow children to operate tractors.

Survey responses suggest that grandparents are more likely than parents to prohibit potentially dangerous farm activities (e.g., riding on tractors, combines, and grain transport vehicles, and operating tractors and ATVs), while parents are more likely to implement strategic safety practices (e.g., having a fire escape plan, and obtaining CPR/first aid training). Survey results also show that Indiana farm families do not meet national goals for the use of bicycle helmets, child seats/seatbelts, or smoke detectors.

Keywords

Farm safety, Agricultural safety, Tractor safety, Questionnaires, Knowledge acquisition

Disciplines

Occupational Health and Industrial Hygiene

Comments

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A survey of Indiana farm homes was conducted in the winter of 1994-1995 to establish realistic baselines concerning child safety practices for populations in rural Indiana for the purpose of: (1) adjusting interventions to target specific issues where prevention efforts are most needed; and (2) evaluating the effectiveness of safety efforts targeting rural Indiana families. A questionnaire was designed to obtain baseline information for child safety practices on Indiana farms, and a stratified random sample of 1,500 Indiana farms (arrayed by county) was selected from a population consisting of all 60,000 Indiana farms. Survey procedures involved two mailings, and phone interviews with non-respondents, which yielded 597 usable questionnaires.

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Despite sharp declines in the farm population and major improvements in the safety of agricultural production activities, the farm remains one of the most hazardous places to work and raise a family (National Safety Council, 1996). No other industry in western industrialized nations exposes children to the same workplace hazards as adult workers. Children are particularly vulnerable to farm-work related hazards—approximately 20% of farm work-related deaths involve children or adolescents under the age of 18 (Stallones and Gunderson, 1994).

Numerous studies have been conducted pertaining to the number of people injured in farm work-related incidents (Stallones and Gunderson, 1994; Whitman

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and Field, 1995; Kelley and Field, 1996; Sheldon and Field, 1995; Pahwa et al., 1995; Stueland et al., 1991). While these studies have extensively analyzed the nature of the injury, the demographics of the victim, and/or the mechanism of injury, few studies have explored the behavioral practices of farmers and their families that specifically affect the safety of their children. Recent exceptions include a survey of Wisconsin dairy farmers concerning factors that influenced their decisions to expose youth to the risks of workplace injuries (Lee et al., 1997) and a focus group study examining how Kentucky farm parents select appropriate tasks and teach safety issues to their children prior to allowing children to perform high-risk chores (Kidd et al., 1997). Although not the focus of the study, Ambe et al. (1994) did examine the practice of allowing children to ride on farm tractors.

Safety initiatives established by governmental agencies usually focus on the general population. This results in baseline measures and objectives that may not be representative of agricultural populations and do not address agricultural activities. It was determined that documenting the child safety practices of farm parents/grandparents would allow safety professionals to more accurately: (1) establish realistic baseline measures of child safety practices; (2) adjust interventions to target specific issues where prevention efforts are most needed; and (3) evaluate the effectiveness of those interventions. This article describes an attempt to establish baseline data for safety practices affecting rural Indiana children.

Methods

The Indiana Agricultural Statistics Service (IASS) was contracted to administer a survey of Indiana farm homes during the winter of 1994-1995. The IASS is the U.S. Department of Agriculture/Purdue University cooperative agency responsible for maintaining statistical records of Indiana agriculture. It routinely conducts surveys of the Indiana farm population, performing sample selection, survey administration, and statistical analysis.

Subject Selection

A stratified random sample of Indiana farms (arrayed by county) was selected from a population of 60,000 Indiana farms as defined by the IASS. No sampling control information exists for the desired population (i.e., Indiana farm families with children or grandchildren present). However, the 1992 Census of Agriculture found that 46% of Indiana farm operations were headed by persons under 50 years of age (most likely to have children in the home). Using this 46% expected occurrence, and a standard error of $\pm 5\%$ (95% confidence interval), the required sample size was calculated using the following formula:

$$SE(p) = \sqrt{\frac{PQ}{n}} \quad (1)$$

where

SE = standard error

P = proportion of occurrence of item

Q = 1 - P

n = required sample size

$$0.025 = \sqrt{\frac{(0.46)(0.54)}{n}} \quad (2)$$

$$n = \frac{0.2485}{0.000625} = 397 \quad (3)$$

While 397 usable surveys were required to draw representative conclusions based on the sample population, the number of issued surveys needed to be larger to allow for non-responses. Previous studies conducted by the IASS have found the average return rate for mail surveys to be 32.5%. Using an expected return rate of 32.5%, it was determined that a total of 1,222 farms should be surveyed. Since the project's budget allowed for a sample size of 1,500, this larger sample size was used. To verify that both the respondents and non-respondents of the mail survey were statistically similar, and thus representative of Indiana farms (i.e., to assure that neither respondents nor non-respondents were biased), at least 100 non-respondents from the mail survey would need to be surveyed by telephone.

A numerical identifier was assigned to each questionnaire. This number was used in all interaction with subjects to maintain confidentiality and to monitor returned questionnaires. The authors had no direct contact with the subjects.

Questionnaire Design

The questionnaire focused on two areas: (1) practices on all farms that may affect the safety of children; and (2) specific child safety practices employed on farms where children reside or frequently visit.

The preliminary questionnaire was evaluated by safety colleagues and IASS staff. Modifications were made and the survey instrument was reviewed again by IASS staff. The questionnaire was then pilot tested to assess the clarity of the instructions, and the usefulness of responses to the questions as written. Additional modifications were made as a result of this process.

As an incentive for completing the questionnaire, the front cover of the questionnaire included an offer for a free gift. The gift consisted of one Careful Country Farm Safety Coloring and Activity Book for each child or grandchild under 10 years of age on the respondent's farm.

Procedure

The questionnaire was mailed to the initial sample set of 1,500 Indiana farm families. This mailing consisted of a hand-signed cover letter, the questionnaire, and a postage-paid business reply envelope. Three weeks after the initial mailing, a second letter (and questionnaire) was mailed to all subjects who had not yet responded. Four weeks after the second mailing, telephone interviews were conducted with a stratified random sub-sample of the non-respondents.

Limitations of This Methodology

As with any mailed survey, it is not possible to verify if the respondents accurately, or honestly, complete the questionnaire. The potential impact of this limitation was reduced by pilot testing the questionnaire, which indicated that the questions were sufficiently comprehensible to allow the respondents to answer accurately. Another potential weakness of mailed surveys concerns the ability to obtain a representative sample of the population of interest. The impact of this

limitation was mediated by using follow-up telephone surveys with non-respondents to test if the respondents were indeed representative of the desired population. The third potential limitation of this study is one of statistical inference, and how that inference affects the conclusions that may be drawn from this study. This particular study was designed to draw conclusions based on proportions and percentages yielded from the sample. Based on the data obtained, any attempt to draw conclusions regarding more sophisticated statistical relationships would be inappropriate.

Results

From the 1,500 farm homes originally selected, 481 usable questionnaires were returned by mail, providing a response rate of 32%. To validate the 481 surveys, an additional 116 questionnaires were completed through telephone interviews with non-respondents of the mail survey. The total response rate was 40% (597 usable questionnaires). Respondents (mail) and non-respondents (phone) differed significantly ($\alpha = 0.05$) on only three questions; which are addressed later in this section. For the remaining results, mail and phone respondents are grouped together and treated as a single sample population.

Indiana Farm Homes

This section was completed by all 597 respondents, therefore, the results are inferred to be representative of all Indiana farm homes. Forty percent (40%) reported that they were parents of school age children, and an additional 39% reported that they were grandparents of school age children. Eighty-one percent (81%) reported having an operational smoke detector on each floor of the home, and 86% reported having at least one fire extinguisher in the home—most commonly in the kitchen. Sixty-one percent (61%) had a fire escape plan for their home, with over half of those plans including detailed escape routes from each room. Approximately 90% said they had a first aid kit, and 59% reported that at least one family member had received first aid and/or CPR training. Approximately one-third reported using some type of mobile communication device(s) on their farm—usually a cellular phone. Two-thirds of those respondents stating that they had ponds and/or manure storage facilities on their farms also reported having fences around these areas to prevent access by children. (See table 1 for more details.)

Indiana Farm Homes with Children

This section was completed by the 479 respondents who indicated that children lived on, or frequently visited, their farm. Thus, inferences made from this section should be representative of all Indiana farm homes with children. As defined in the questionnaire, the term children refers to persons under age 18 that live on, and/or frequently visit the subject's farm. Frequent visitors could be persons such as grandchildren, nieces, or nephews. Similarly, the term farms with children refers to farms where persons under age 18 live and/or frequently visit.

Table 2 shows the percentage of farm parents/grandparents who reported that at least some of their children had participated in formal swimming lessons, required children to wear bicycle helmets, and allowed children to operate ATVs, ride on gravity-flow wagons or trucks loaded with grain, or ride as passengers on tractors and/or combines.

Table 1. Results representative of all Indiana farm homes

Item	Yes	95% CI*
Do you have an operational smoke detector on each floor of your home?†	81%	(78-84)
Do you have at least one fire extinguisher in your homes†	86%	(83-89)
Indicate where fire extinguishers are located:‡		
Kitchen	59%	(55-63)
Utility room	26%	(22-30)
Garage	22%	(18-26)
Does your family have a fire escape plan?	61%	(57-65)
If yes, does the plan show detailed escape routes from each room in your home?	57%	(53-61)
Respondents who indicated that they had at least one first aid kit on their farm.	93%	(89-97)
Indicate where first aid kits are located:‡		
Home	95%	(93-97)
Pickup/car	36%	(32-40)
Farm shop	23%	(19-27)
Has any member of your family received first aid and/or CPR training?	59%	(55-63)
Respondents who indicated that they used at least one type of mobile communication device on their farm.	32%	(28-36)
Type of mobile communication device used:		
Cellular telephone	59%	(52-66)
FM band 2-way radio	38%	(31-45)
CB radio	29%	(22-36)
Pagers/beepers	11%	(7-15)
Are farm ponds and manure storage facilities on your farm fenced to prevent access by children?§	67%	(62-72)

* Confidence interval in percent.

† Some respondents reported that they were “not sure”.

‡ These are only the top three locations for only those who indicated that they had them

§ 48% of all respondents indicated that this question was “not applicable” to them. Thus, these values are only for the 52% who indicated that they had farm ponds and manure storage facilities on their farm.

Respondents who indicated that they allow children to ride as passengers on tractors and/or combines were asked at what age they first allowed children to participate in this activity. Nearly half reported children doing so by age 3, and almost all reported allowing children to do so by age 10. The age at which children were first allowed to ride as passengers ranged from less than 1 year to 14 years, with the average age for first-time riders being 4 1/2 years. Figure 1 shows the cumulative percentage of children riding as passengers by selected ages for farms where the activity is allowed.

Survey participants who reported that children were allowed to operate tractors were also asked the age at which children were first allowed to do so. Responses ranged from 4 years to 16 years, with an average age of 11 years. Approximately three-quarters (78%) reported children operating tractors by age 12, and over 90% by age 14. Respondents also indicated that most of the training prior to operation was provided by the children's parents. The cumulative percentage of children operating tractors by selected ages for farms where the activity is allowed is shown in figure 2.

Table 2. Results representative of Indiana farm homes with children

Item	Yes	95% CI*
Have your children participated in formal swimming lessons offered by Red Cross, YMCA, etc?	62%	(58-66)
Are your children required to wear helmets while riding bicycles?	26%	(22-30)
Do children operate ATVs on your farm?	29%	(25-33)
Respondents who indicated that children were "always" required to wear helmets on ATVs.†	42%	(33-51)
Do you allow children to ride on gravity flow wagons or trucks loaded with grain?	5%	(3-7)
Are children allowed to ride as passengers on tractors or combines on your farm?	63%	(59-67)
Do children operate tractors on your farm? 36% (32-40)		

* Confidence interval in percent.

† Only 17% indicated that children were "never" required to wear helmets while operating ATVs. The remaining respondents indicated that helmets were "sometimes" required.

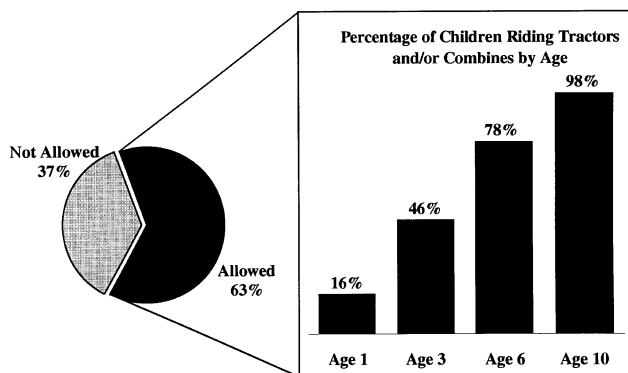


Figure 1—Percentage of children allowed to ride on tractors and/or combines.

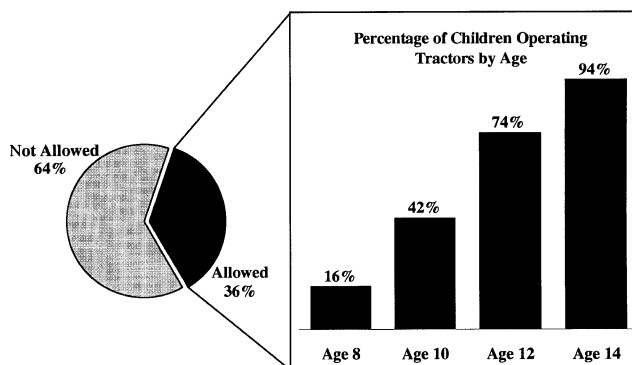


Figure 2—Percentage of children allowed to operate tractors and/or combines.

Differences Between Respondents and Non-Respondents

Responses between respondents (mail) and non-respondents (telephone) differed significantly ($\alpha = 0.05$) on only three questions.

Respondents who returned the mail survey were more likely than those contacted by telephone to have children living on or frequently visiting their farm (82% vs 73%). Of the farms with children present, 31% of the telephone respondents and 16% of the mail respondents reported having a fenced play area separated from work areas. Finally, 56% of the telephone respondents and 50% of the mail respondents reported “always” using approved child safety seats or seatbelts in the primary farm vehicle (e.g., pickup); and 9% of mail respondents and 21% of the phone respondents indicated that children were “never” secured in approved child safety seats or seatbelts in the primary farm vehicle.

Comparisons Between Subgroups

The purpose of this study was to establish data for rural safety issues such as presence of smoke detectors, use of passenger restraints, and children operating farm tractors/equipment. In addition, this study also explored potential differences between subgroups such as parents and grandparents, and farms with children present versus farms without children present. Potential differences were investigated using a chi-square statistic to test the null hypothesis that there were no differences between any of the subgroups (Montgomery, 1991). All correlations where a significant ($\alpha = 0.05$) difference between any two subgroups was found are presented here. The importance and/or implications of these findings are discussed in the next section.

Parents vs Grandparents. There were seven questions that showed a significant difference comparing parents vs grandparents. Grandparents were more likely ($P = 0.001$) to require children to wear helmets when riding bicycles. On farms with ATVs, children were less likely ($P < 0.0005$) to operate ATVs if the farm belonged to their grandparents. Grandparents were also less likely than parents to allow children to ride on tractors and/or combines ($P < 0.0005$), ride on grain wagons or trucks loaded with grain ($P = 0.004$), and operate tractors ($P < 0.0005$). Parents were more likely than grandparents to have a fire escape plan for the home ($P < 0.0005$), and to have at least one family member with first aid and/or CPR training ($P < 0.0005$). Table 3 provides a summary of the comparisons between parents and grandparents.

Other Subgroups. Respondents from farms with children were more likely than respondents without children to have an operational smoke detector on each floor of their home (84% vs 73%; $P = 0.013$), and were more likely to have at least one family member with first aid and/or CPR training (63% vs 45%; $P = 0.001$). Families with a smoke detector on each floor were more likely to have a fire extinguisher (90% vs

Table 3. Comparison of parents vs grandparents

Parents are more likely than grandparents to:

- Have a fire escape plan for their home (73% vs 52%)
- Have a family member with first aid and/or CPR training (71% vs 51%)
- Allow children to ride as passengers on tractors and combines (76% vs 51%)
- Allow children to operate tractors (51% vs 20%)
- Allow children to operate ATVs (38% vs 21%)

Parents are less likely than grandparents to:

- Require the use of bicycle helmets (20% vs 35%)
 - Prohibit children from riding on grain transport vehicles (93% vs 98%)
-

73%; $P < 0.0005$), and a fire escape plan (65% vs 44%; $P < 0.0005$). Similarly, when at least one family member was trained in first aid and/or CPR, these families were also more likely to have an operational smoke detector on each floor of their home (86% vs 76%; $P = 0.001$), and a fire escape plan (67% vs 52%; $P < 0.0005$).

Discussion

As with other national safety efforts in western industrialized nations, the United States Department of Health and Human Services has established specific safety goals (in 1991) to be accomplished by the year 2000. Table 4 lists three of these national goals, and the corresponding results obtained in this study (considering only Indiana farmers and their families).

The findings illustrate that Indiana farm families fall short of meeting the goals established by the U.S. government in all three of the safety categories discussed. Additional intervention efforts must be initiated in these areas if the goals established by the U.S. government are to be met by the year 2000. One of these issues, the use of child safety restraints, is currently legislated. Indiana law states that children two years old and under need to be restrained in a child safety seat, children 3 to 4 years of age need to be restrained in a child safety seat or by the seatbelt, and children five years old or older need only be restrained in the front seat. Pickups and other farm vehicles are not exempted from child restraint laws as they are for adult seatbelt usage. The results of this study indicate restraint usage of approximately 50% in the primary farm vehicle. This level of use is consistent with the authors' observations of use and lack of enforcement concerning this issue.

Numerous studies of agricultural fatalities have examined the nature of injuries, the various injury causing agents, and the demographics of injury victims. Some of these studies (Stallones and Gunderson, 1994; Sheldon and Field, 1995; Stueland et al., 1991) have focussed exclusively on the problem of farm work-related fatalities among children. However, little has been published exploring the behavioral practices employed by farmers and their families to ensure the safety of their children. Exceptions include (1) an informal study of 421 farm families with children age 15 and younger conducted by *Successful Farming* magazine (Tevis and Finck, 1989); (2) portions of Ambe et al. (1994) who investigated the perceptions of 288 Pennsylvania tractor operators concerning tractor safety issues; (3) a survey of Wisconsin dairy farmers concerning the factors that influenced their decisions to allow youth to drive tractors, ride as a passenger on a tractor without a cab, and be within five feet of the hind legs of a dairy cow (Lee et al., 1997); and (4) a focus group study of Kentucky farm families addressing safety practices associated with youth performing farm tasks (Kidd et al., 1997).

Successful Farming reported that nearly all farm parents surveyed permitted their children to ride with them on tractors, and likewise, permitted youth to operate farm tractors. In contrast, the current study found that a significant percentage of Indiana

Table 4. U.S. safety goals and current status among Indiana farm families

Safety Category	U.S. Goal, Year 2000	Current Status, This Study
Bicycle helmet usage	50%	26%
Automotive child safety seat and seatbelt usage with children	85%	51%
Smoke detectors (one per inhabited floor of each home)	100%	81%

farm residents with children do not allow children to ride as passengers on tractors and/or combines (37%), or to operate tractors (64%). Kidd et al. (1997) reported similar results for tractor operation among the 36 farm families who participated in their focus group study. However, among Indiana farmers who allow children to ride on and operate tractors, children are allowed to first participate in these activities at ages similar to those reported in the Successful Farming study. Ninety-eight percent (98%) of all children (on Indiana farms where children are allowed to ride on tractors and/or combines) are riding as passengers by age 10 (fig. 1). This finding is similar to the figure reported in the Successful Farming study (95% males, 84% females). Ninety-four percent (94%) of all children (on Indiana farms where children are allowed to operate tractors) are operating tractors by age 14 (fig. 2). The Successful Farming study reported similar findings (94% males, 56% females). The average age for initial tractor operation on Indiana farms (11 years) is slightly higher than the 9.4 years on Kentucky farms reported by Kidd et al. (1997). The results shown in figures 1 and 2 indicate that, among parents and grandparents still allowing children to ride on and operate tractors, little has changed, even with an increased emphasis on childhood farm safety issues in recent years. Although a direct comparisons are not possible, Ambe et al. (1994) found that tractor operators were more likely to occasionally allow children to ride on tractors as the children grew older. Additionally, Lee et al. (1997) reported that Wisconsin dairy farm fathers were quite likely to allow youth 10 to 14 years of age to operate tractors and this willingness increased with the age of the child.

The fact that young children are still operating tractors on Indiana farms suggests that traditional tractor safety programs designed for high school agricultural education programs may occur too late to be effective intervention strategies. Many Indiana farm children begin operating tractors before they are eligible (by age) to participate in these traditional tractor safety programs. This is corroborated by the number of respondents who reported that most of the tractor safety education children received prior to operating a tractor, if any, was provided by the parents. These results also suggest that while more emphasis should be placed on educating parents about the risks associated with young operators, programs must also focus on improving parents' ability to provide adequate safety training. Considering that tractors and machinery consistently rank as the leading cause of childhood farm work-related fatalities (Sheldon and Field, 1995; Stallones and Gunderson, 1994), the high number of young children riding on and operating tractors presents a serious challenge to injury prevention efforts.

Gravity-flow wagons are popular grain transport vehicles in the United States. Frequently, small children will play in the grain inside a gravity-flow wagon or ride on the wagon as it is transported from the field to on-farm grain storage facilities. The risk of injury occurs when small children are not removed from the grain prior to unloading, and are thus exposed to a suffocation hazard should they be pulled under the flowing grain as the wagon is unloaded. While the frequency of injuries associated with gravity-flow wagons is relatively small (Kelley and Field, 1996), the severity of the resulting injuries (usually fatal) makes the practice of allowing small children to ride in gravity-flow wagons a serious problem. Five percent (5%) of the families in this study allow their children to ride on grain transport vehicles such as gravity-flow wagons.

This study found that grandparents are more likely than parents to set limits for children regarding safety practices, a finding supported by the Successful Farming study (Tevis and Finck, 1989). The literature on risk assessment and safety behavior documents that people assign a low risk value to a particular activity when they feel

they have control or are familiar with the potential hazard (Slovic, 1987; Sandman, 1993; Rowan, 1991). Other factors may also influence parents' willingness to allow their children to participate in potentially hazardous activities. These may include: (1) parents' confidence in working with machinery may translate to confidence in their own children's ability to perform tasks that they would normally deem unsafe for other children; (2) parents' belief that their own children are more capable and mature than other children may result in them allowing their own children to perform tasks that they would normally deem unsafe for other children; (3) parents generally spend more time with their children than the grandparents do, and therefore may be less protective; (4) grandparents spend less time with the children, therefore, it may be easier for grandparents to consistently enforce safety rules; and/or (5) grandparents may, based on experience, realize that children are more vulnerable than the parents do. These characteristics, while not totally understood, do have implications for injury prevention programs. For example, the results of this study indicate that programming efforts developed for farm parents should place more emphasis on hazard recognition and methods for more objectively evaluating their children's ability to safely perform farm tasks. On the other hand, childhood injury prevention programs targeting farm grandparents should stress the importance of strategic safety measures such as installing smoke detectors.

The positive correlations between the presence of smoke detectors and fire extinguishers, and between the presence of smoke detectors and fire escape plans, were expected. If a family has at least one operational smoke detector on each floor of their home, it logically follows that they would be more aware of the risk of fires and the importance of early detection. This awareness would likely translate to the adoption of additional fire safety strategies such as placing fire extinguishers in the house and developing a family fire escape plan.

Conclusions and Recommendations

As a result of this study, appropriate baselines for practices impacting the safety of children on Indiana farms have been established. These baselines can now be used, in conjunction with future survey data, to provide a quantitative measure of changes in childhood safety-related practices on Indiana farms. The baseline data, coupled with future studies, should prove beneficial in analyzing the effectiveness of various prevention strategies designed to alter practices affecting the safety of rural children in Indiana and throughout North America.

Recommendations for Future Work

1. Additional intervention programs targeting rural audiences will be required to bring rural Indiana families in line with the safety goals established by the United States government for the year 2000 in the following areas: (1) the use of bicycle helmets; (2) the use of seatbelts and child safety seat in farm vehicles; and (3) the presence of functional smoke detectors on each inhabitable floor.
2. Additional prevention programs targeting farm parents and grandparents, as well as farm children, are needed in the following areas: (1) hazard recognition; and (2) assigning appropriate farm work-related tasks that children can perform safely at different developmental stages.
3. The value of tractor safety programs in 4-H (a U.S. non-formal educational program for youth ages 10-19) and high school agricultural education

programs should be re-evaluated with the understanding that most Indiana farm children riding on, and operating, tractors are doing so before they are old enough to participate in these formal safety programs. Consequently, most of the safety training a child receives prior to operating a tractor is provided by parents and other family members. While the continuing focus of safety efforts should be to decrease the number of young children operating tractors (see number 2), there is also a need for educational programs aimed at enhancing parents' ability to provide adequate tractor safety education to their children. The tractor safety certification program (an enforcement program administered by the U.S. Department of Labor) needs to be evaluated for appropriateness and effectiveness. Currently the program only applies to youth working for hire on a farm other than their parents/guardians. Thus, this program impacts a very small percent of the youth working on U.S. farms.

4. Considering that parents and grandparents seem to have different concerns and priorities regarding child safety, further research should be conducted to determine why such differences exist, and what intervention methods/approaches are most effective with each respective audience. These differences should also influence the content of intervention programs targeting parents and grandparents. In particular, injury prevention efforts should encourage parents to take a more active role in setting realistic goals and enforceable limits for their children in regard to certain activities and work tasks (e.g., tractor operation). Likewise, if children are to be regular visitors, grandparents should be encouraged to implement strategic preventions (e.g., fire escape plans).
5. This study did not attempt to collect the data necessary to explore relationships between current safety practices and other potential variables that impact injuries (e.g., prior injury experience; type of farming operation; size of farming operation; and other demographic factors such as age, gender, and number of children present). Future research efforts should explore possible correlations, and attempt to assess the potential impacts of these possible relationships on the design of injury prevention programs.

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